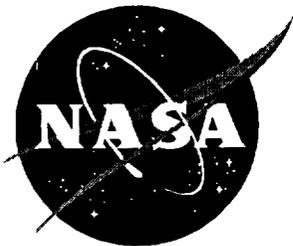


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## National Educators' Workshop: Update 97

### *Standard Experiments in Engineering Materials, Science, and Technology*

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## PREFACE

**NEW:Update 97**, hosted by Boeing Commercial Airplane Company in Seattle, Washington, on November 2 - 5, 1997, marked our second workshop west of the Mississippi. Seattle took a break from heavy rains and provided beautiful weather.

We built on past themes, activities, and presentations based on extensive evaluations from participants of previous workshops. This **12th annual NEW:Update** continued to the work of strengthening materials education. About 120 participants witnessed demonstrations of experiments, discussed issues of materials science and engineering (MSE) with people from education, industry, government, and technical societies; heard about new MSE developments; and chose from nine, three-hour mini workshops in state-of-the-art Boeing production facilities and R&D laboratories to attend. Faculty in attendance represented high schools, community colleges, smaller colleges, and major universities. Undergraduate and graduate students also attended and presented.

The generous fashion in which Alan Miller and Brian Smith, and the many scientist, engineers, and other staff of Boeing, provided funding, opened their facilities, developed presentations and activities, and acted as all around gracious hosts insured the on-going quality of this important educational series of workshops. With the very demanding production schedule Boeing faces, we are indebted for their sacrifices in hosting this workshop.

**NEW:Update 97** participants saw the demonstration of about forty experiments and aided in evaluating them. We also heard updating information relating to materials science, engineering and technology presented at mini plenary sessions that focused on technology from aircraft and automotive technology, and materials research at Brookhaven National Lab. Through the considerable efforts of Kris Kern at LANL, Raj Chaudhury of NSU, and Roger Marshall and William Gerds of Boeing, most of the workshop was broadcast over the Internet.

The experiments in this publication can serve as a valuable guide to faculty who are interested in useful activities for their students. The material was the result of years of research aimed at better methods of teaching materials science, engineering and technology. The experiments were developed by faculty, scientists, and engineers throughout the United States. There is a blend of experiments on new materials and traditional materials. Uses of computers in MSE, designing experiments, and a variety of low-cost experiments were among the demonstrations presented.

Experiments underwent an extensive peer review process. After submission of abstracts, selected authors were notified of their acceptance and given the format for submission of experiments. Experiments were reviewed by a panel of specialists through the cooperation of the Materials Education Council. Most authors received comments from the panel prior to **NEW:Update 97**, allowing them to make necessary adjustments prior to demonstrating their experiments. Comments from workshop participants provided additional feedback which authors used to make final revisions which were submitted for the NASA editorial group for this publication.

The Materials Education Council of the United States publishes selected experiments in the *Journal of Materials Education (JME)*. The international *JME* offers valuable teaching and curriculum aids including instructional modules on emerging materials technology, experiments, book reviews, and editorials to materials educators. On a personal note, MEC honored Jim Jacobs as "1996 Materials Educator of the Year" at the December MRS meeting in Boston. This award must be shared with all the people who have contributed to the NEW:Update series, our textbooks, and the many activities of our national materials education network.

Videotapes were made of the workshop by Boeing. Transparency masters for the mini plenary sessions are included in this publication. As with previous NEW:Updates, critiques were made of the workshop to provide continuing improvement of this activity. The evaluations and recommendations made by participants provide valuable feedback for the planning of subsequent NEW:Updates.

NEW:Update 97 and the series of workshops that go back to 1986 are, to our knowledge, the only national workshops or gatherings for materials educators that have a focus on the full range of issues and strategies for better teaching about the entire complement of materials. NEW:Update 97, with its diversity of faculty, industry, and government MSE participants, served as a forum for both formal and informal issues facing MSE education that ranged from the challenges of keeping faculty and students abreast of new technology to ideas to ensure that materials scientists, engineers, and technicians maintain the proper respect for the environment and human safety in the pursuit of their objectives.

We demonstrated the *Experiments in Materials Science, Engineering & Technology. (EMSET) CD-ROM* with all 213 experiments from the first decade of NEW:Updates. This CD ROM is another example of cooperative efforts to support materials education. The primary contributions came from the many authors of the demo and experiments for NEW:Updates. Funding for the CD came from both private industry and federal agencies. Please see the attached information for obtaining the CD set.

We express our appreciation to all those who helped to keep this series of workshops viable. Special thanks goes to those on the planning committee, management team, hosts, sponsors, and especially those of you have developed and shared your ideas for experiments, demonstrations, and novel approaches to learning. All of us who participated in the workshop appreciated the excellent coordination of activities by Diana LaClaire, Kirsten Maassen, and Ginger Freeman.

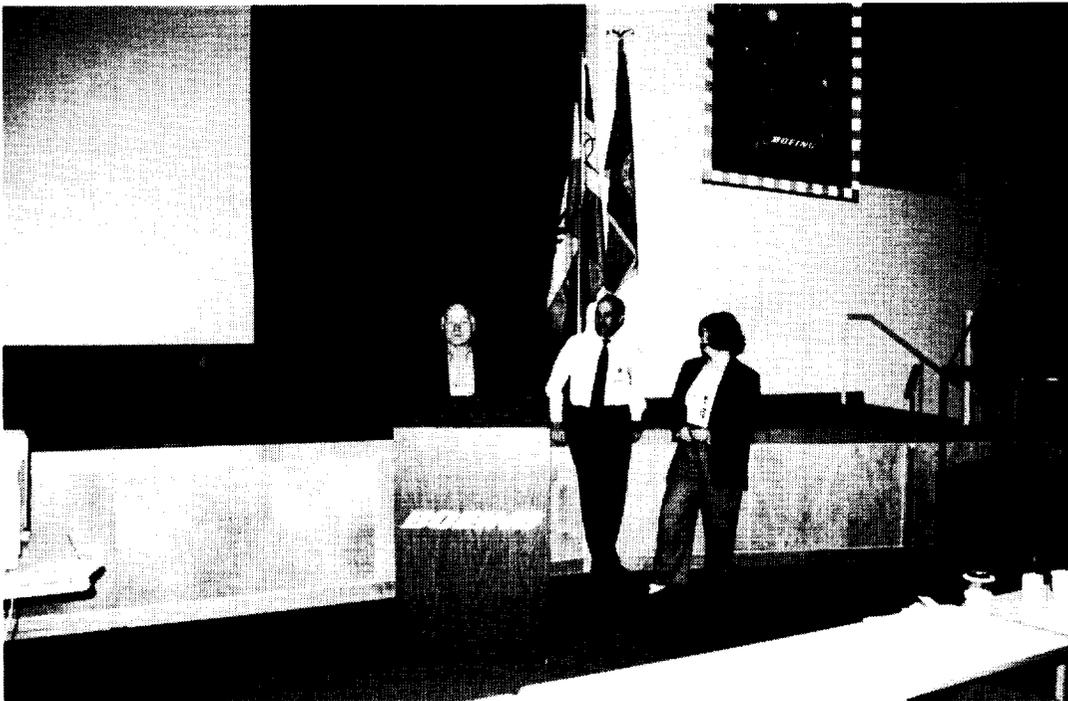
We hope that the experiments presented in this publication will assist you in teaching about materials science, engineering and technology. We would like to have your comments on their value and means of improving them. Please send comments to Jim Jacobs, School of Technology, Norfolk State University, Norfolk, Virginia 23504.

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WELCOME



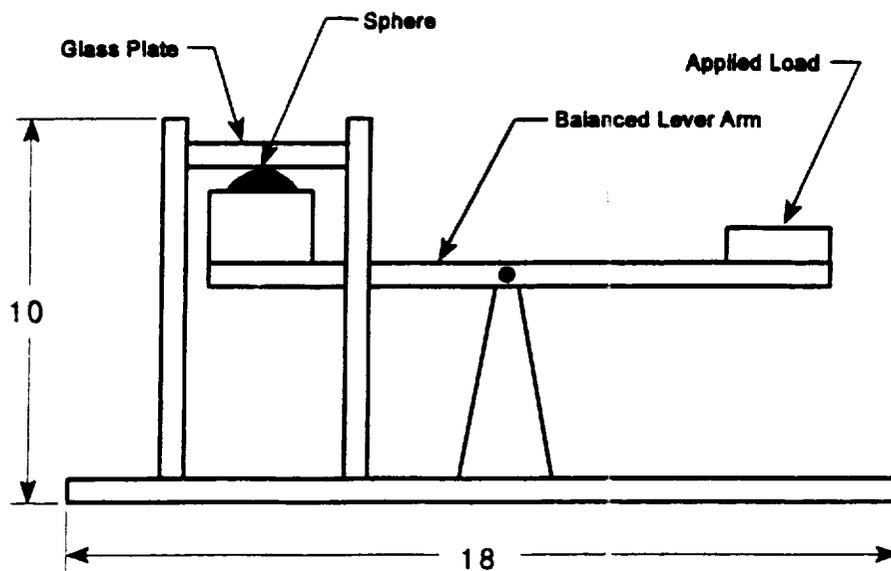
Len Fine and Jim Jacobs



# NATIONAL EDUCATORS' WORKSHOP

Update 97: Standard Experiments  
in Engineering Materials, Science,  
and Technology

November 2 - 5, 1997 - Boeing Commercial Airplane Company



Sponsored by

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Jacobs, James A., McKenney, Alfred E. "213 Experiments on CD-ROM From 10 Years of NEW:Updates"

Kayser, Jack R. "Structural Laboratory Manual"

Russ, John C. "Impact of Multimedia and Network Services on an Introductory Level Course"

Sawyer, W. Gregory, Bryson, Daniel, Svanes, Torkel, and Hudson, John B. "Effective Learning Through Interactive Computer Simulation and Experimentation."

Shackelford, James F., Meier, Michael. "Computer Applications For The Materials Laboratory/Classroom: Illustrating Structure and Diffraction"

Swyler, Karl J., Fine, Leonard W. "Preview of NEW:Update 98"

Winter, John M. Jr., Lipetzky, Kirsten G. "X-Ray Radiographic Exercises for an Undergraduate Materials Lab"

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NASA Conference Publication 3259

Bright, Victor M. "Simulation of Materials Processing: Fantasy or Reality?"

Diwan, Ravinder M. "Manufacturing Processes Laboratory Projects in Mechanical Engineering Curriculum"

Kundu, Nikhil K. "Graphing Techniques for Materials Laboratory Using Excel"

McClelland, H. T. "Process Capability Determination of New and Existing Equipment and Introduction to Usable Statistical Methods"

Passek, Thomas "University Outreach Focused Discussion: What Do Educators Want From ASM International"

### NEW:Update 94

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Brimacombe, J. K., "Transferring Knowledge to the Shop Floor"

Burte, Harris M., "Emerging Materials Technology"

Constant, Kristen P. and Vedula, Krishna, "Development of Course Modules for Materials Experiments"

Coyne, Jr., Paul J., Kohne, Glenn S., Elban, and Wayne L., "PC Laser Printer-Generated Cubic Stereographic Projections with Accompanying Student Exercise"

Masi, James V., "Bubble Rafts, Crystal Structures, and Computer Animation"

McKenney, Alfred E., Evelyn D., and Berrettini, Robert, "CD-ROM Technology to Strengthen Materials Education"

Olesak, Patricia J., "Understanding Phase Diagrams"

Scheer, Robert J., "Incorporating "Intelligent" Materials into Science Education"

Schwartz, Lyle H., "Technology Transfer of NIST Research"

Spiegel, F. Xavier, "Demonstrations in Materials Science From the Candy Shop"

Uhl, Robert, "ASM Educational Tools Now and Into the Future"

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Berrettini, Robert, "The VTLA System of Course Delivery and Faculty in Materials Education"

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Russ, John, "Self-Paced Interactive CD-ROMS"

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Gulden, Terry D., Winter, Patricia, "Explorations in Materials Science"

McKelvy, Michael J., Birk, James P., Ramakrishna, B. L., "Bringing Advanced Experimental Technology Into Education"

McMahon, Jr., Charles J., "Labs on Videotape for Materials Science and Engineering"

Parkin, Don M., "Los Alamos - The Challenging World of Nuclear Materials Science"

Pendleton, Stuart E., "Next Generation Multimedia Distributed Data Base Systems"

Russ, John C., "Impact of Multimedia and Network Services on an Introductory Level Course"

Spiegel, F. Xavier, "NEW:Update, The Experience of One College"

Wilkerson, Amy, Self, Donna, Rodriguez, Waldo J., Ries, Heidi R., "A "Problem Based Learning" Approach to Reflection and Refraction"

Winter, Patricia S., "Business Involvement in Science Education"

## **EXPERIMENTS & DEMONSTRATIONS IN MATERIALS SYSTEMS**

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**NIST Special Publication 822**

Halperin, Kopl. "Design Project for the Materials Course: To Pick the Best Material for a Cooking Pot"

### **NEW:Update 96**

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Aceves, Salvador M., Smith, J. Ray, Johnson, Norman L., "Computer Modeling in the Design and Evaluation of Electric and Hybrid Vehicles"

Benjamin, Robert F., "Experiments Showing Dynamics of Materials Interfaces"

Daugherty, Mark A., "Electrolytic Production of Hydrogen Utilizing Photovoltaic Cells"

Fine, Leonard W., "The Incandescent Light Bulb"

MacKenzie, James J., "Hydrogen -- The Energy Carrier of the Future"

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Bunnell, L. Roy. "Weakening of Latex Rubber by Environmental Effects"

Chadwick, Margaret. "Automotive Materials For the Next Millennium"

Lund, David W. "High Speed Civil Transport - Design Challenges"

## **EXPERIMENTS & DEMONSTRATIONS IN ELECTRONIC AND OPTICAL MATERIALS**

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**NASA Conference Publication 3060**

Sastri, Sankar. "Magnetic Particle Inspection"

### **NEW:Update 89**

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Kundu, Nikhil K. and Kundu, Malay. "Piezoelectric and Pyroelectric Effects of a Crystalline Polymer"

Molton, Peter M. and Clarke, Clayton. "Anode Materials for Electrochemical Waste Destruction"

Ries, Heidi R. "Dielectric Determination of the Glass Transition Temperature"

### **NEW:Update 90**

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Dahiya, J. N. "Dielectric Behavior of Superconductors at Microwave Frequencies"

### **NEW:Update 91**

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Dahiya, J. N. "Dielectric Behavior of Semiconductors at Microwave Frequencies"

Patterson, John W. "Demonstration of Magnetic Domain Boundary Movement Using an Easily Assembled Videocam-Microscope System"

### **NEW:Update 92**

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Bunnell, L. Roy. "Temperature-Dependent Electrical Conductivity of Soda-Lime Glass"

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### **NEW:Update 94**

**NASA Conference Publication 3304**

Elban, Wayne L., "Stereographic Projection Analysis of Fracture Plane Traces in Polished Silicon Wafers for Integrated Circuits"

Parmar, Devendra S. and Singh, J. J., "Measurement of the Electro-Optic Switching Response in Ferroelectric Liquid Crystals"

### **NEW:Update 95**

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Dahiya, Jai N., "Temperature Dependence of the Microwave Dielectric Behavior of Selected Materials"

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### **NEW:Update 96**

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Jain, H., "Learning About Electric Dipoles From a Kitchen Microwave Oven"

### **NEW:Update 97**

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Draayer, B. F., Dahiya, J. N. "A Computerized Microwave Spectrometer for Dielectric Relaxation Studies"

Ferguson, Luke, Stoebe, Thomas. "Properties of Magnetic Ferrites With a Simple Fabrication Method"

Marshall, John A. "Magneto-Rheological Fluid Technology"

Umana, Carlos E. "How to Compute the Atomic Magnetic Dipole Moment of An Element: An Engineering Approach"

Vanasupa, Linda, Braun, David. "The Human Half-Adder: Understanding the Big Picture of Digital Logic"

Warren, Matthew E., Loutts, George. "Optical Experiments With Manganese Doped Yttrium Orthoaluminate, A Potential Material For Holographic Recording and Data Storage"

## **EXPERIMENTS & DEMONSTRATIONS IN COMPOSITES**

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**NASA Conference Publication 3060**

Nelson, James A. "Composites: Fiberglass Hand Laminating Process"

### **NEW:Update 89**

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Beardmore, Peter. "Future Automotive Materials - Evolution or Revolution"

Chung, Wenchiang R. "The Assessment of Metal Fiber Reinforced Polymeric Composites"

Coleman, J. Mario. "Using Template/Hotwire Cutting to Demonstrate Moldless Composite Fabrication"

### **NEW:Update 90**

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Bunnell, L. R. "Simple Stressed-Skin Composites Using Paper Reinforcement"

Schmenk, Myron J. "Fabrication and Evaluation of a Simple Composite Structural Beam"

West, Harvey A. and Sprecher, A. F. "Fiber Reinforced Composite Materials"

### **NEW:Update 91**

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Greet, Richard J. "Composite Column of Common Materials"

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Thornton, H. Richard. "Mechanical Properties of Composite Materials"

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Masters, John "ASTM Methods for Composite Characterization and Evaluation"

Webber, M. D. and Harvey A. West. "Continuous Unidirectional Fiber Reinforced Composites:  
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### **NEW:Update 95**

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Craig, Douglas F., "Role of Processing in Total Materials"

Wilkerson, Amy Laurie, "Computerized Testing of Woven Composite Materials"

### **NEW:Update 97**

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Cadwell, John and Eric, Piippo, Steven. "Strength Testing of Composite Materials"

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Hartwig, K. T., Haouaoui, M., Cornwell, L. R. "Alloy Composition Determinations"

Bunnell, L. Roy, Piippo, Steven W., "Evaluation of Chemically Tempered Soda-Lime-Silica Glass by Bend Testing"

Dahiya, J. N., "Microwave Measurements of the Dielectric Relaxation in Different Grain Size Crystals of BaTiO<sub>3</sub>"

Masi, James V., "Experiments in Sol-Gel: Hydroxyapatite and YBCO"

Stang, Robert G., "The Effect of Surface Treatment on the Strength of Glass"

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Schull, Robert D. "High T<sub>c</sub> Superconductors: Are They Magnetic?"

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Beardmore, Peter. "Future Automotive Materials - Evolution or Revolution"

Bunnell, L. Roy. "Hands-On Thermal Conductivity and Work-Hardening and Annealing in Metals"

Link, Bruce. "Ceramic Fibers"

Nagy, James P. "Austempering"

Ries, Heidi R. "Dielectric Determination of the Glass Transition Temperature"

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Dahiya, J. N. "Dielectric Behavior of Superconductors at Microwave Frequencies"

Jordan, Gail W. "Adapting Archimedes' Method for Determining Densities and Porosities of Small Ceramic Samples"

Snail, Keith A., Hanssen, Leonard M., Oakes, David B., and Butler, James E. "Diamond Synthesis with a Commercial Oxygen-Acetylene Torch"

### **NEW:Update 91**

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Bunnell, L. Roy. "Tempered Glass and Thermal Shock of Ceramic Materials"

Craig, Douglas F. "Structural Ceramics"

Dahiya, J. N. "Dielectric Behavior of Semiconductors at Microwave Frequencies"

Weiser, Martin W., Lauben, David N., and Madrid, Philip. "Ceramic Processing: Experimental Design and Optimization"

### **NEW:Update 92**

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Bunnell, L. Roy. "Temperature-Dependent Electrical Conductivity of Soda-Lime Glass"

Henshaw, John M. "Fracture of Glass"

Stephan, Patrick M. "High Thermal Conductivity of Diamond"

Vanasupa, Linda S. "A \$69 Look at Thermoplastic Softening"

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Bunnell, L. Roy and Stephen Piippo, "Property Changes During Firing of a Typical Porcelain Ceramic"

Burchell, Timothy D. "Developments in Carbon Materials"

Dahiya, J.N., "Dielectric Measurements of Selected Ceramics at Microwave Frequencies"

Ketron, L.A. "Preparation of Simple Plaster Mold for Slip Casting and Slip Casting"

Masi, James V. "Experiments in Diamond Film Fabrication in Table Top Plasma Apparatus"

Werstler, David E. "Microwave Sintering of Machining Inserts"

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Bunnell, L. Roy and Piippo, Steven, "The Development of Mechanical Strength in a Ceramic Material During Firing"

Long, William G., "Introduction to Continuous Fiber Ceramic Composites"

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West, Harvey A. & Spiegel, F. Xavier, "Crystal Models for the Beginning Student: An Extension to Diamond Cubic"

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Halperin, Kopl, Eccles, Charles, and Latimer, Brett, "Inexpensive Experiments in Creep and Relaxation of Polymers"

Kern, Kristen and Ries, Heidi R., "Dielectric Analysis of Polymer Processing

Kundu, Mukul and Kundu, Nikhil K., "Optimizing Wing Design by Using a Piezoelectric Polymer"

Kundu, Nikhil K. and Wickman, Jerry L., "An Affordable Materials Testing Device"

Stienstra, David, "In-Class Experiments: Piano Wire & Polymers"

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Fine, Leonard W., "Polybutadiene (Jumping Rubber)"

Liu, Ping, and Waskom, Tommy L., "Plastic Recycling Experiments in Materials Education"

Liu, Ping, and Waskom, Tommy L., "Compression Molding of Composite of Recycled HDPE and Recycled Tire Chips"

Masi, James V., "Experiments in Natural and Synthetic Dental Materials: A Mouthful of Experiments"

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Brindos, Richard, Selvaduray, Guna, "Effect of Temperature on Wetting Angle"

Liu, Ping, Waskom, Tommy L., "Making Products Using Post Consumer Recycled High Density Polyethylene: A Series of Recycling Experiments"

Spiegel, F. Xavier, "Elasticity, Plasticity and Anelasticity: Demonstrations"

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Gorman, Thomas M. "Relationship Between Moisture Changes and Dimensional Change in Wood"

Karplus, Alan K. "Stretchy "Elastic" Bands"

Liu, Ping, Waskom, Tom L. "Study of Rheological Behavior of Polymers"

Sullivan, Laura L. "Correlation of Birefringent Patterns to Retained Orientation in Injection Molded Polystyrene Tensile Bars"

Umana, Carlos E. "The Combined Effect of Thermal Conductivity and Thermal Expansion in a PMMA Plastic Heated by Thermal Radiation"

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- Chung, Wenchiang R. "The Assessment of Metal Fiber Reinforced Polymeric Composites"
- Greet, Richard and Cobaugh, Robert. "Rubberlike Elasticity Experiment"
- Kern, Kristen T., Harries, Wynford L., and Long, Sheila Ann T. "Dynamic Mechanical Analysis of Polymeric Materials"
- Kundu, Nikhil K. and Kundu, Malay. "Piezoelectric and Pyroelectric Effects of a Crystalline Polymer"
- Kundu, Nikhil K. "The Effect of Thermal Damage on the Mechanical Properties of Polymer Regrinds"
- Stibolt, Kenneth A. "Tensile and Shear Strength of Adhesives"
- Widener, Edward L. "Industrial Plastics Waste: Identification and Segregation"
- Widener, Edward L. "Recycling Waste-Paper"

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### NIST Special Publication 822

- Brostow, Witold and Kozak, Michael R. "Instruction in Processing as a Part of a Course in Polymer Science and Engineering"
- Cornwell, L. R., Griffin, R. B., and Massarweh, W. A. "Effect of Strain Rate on Tensile Properties of Plastics"
- Gray, Stephanie L., Kern, Kristen T., Harries, Wynford L., and Long, Sheila Ann T. "Improved Technique for Measuring Coefficients of Thermal Extension for Polymer Films"
- Humble, Jeffrey S. "Biodegradable Plastics: An Informative Laboratory Approach"
- Kundu, Nikhil. "Environmental Stress Cracking of Recycled Thermoplastics"
- Wickman, Jerry L. and Corbin, Scott M. "Determining the Impact of Adjusting Temperature Profiles on Photodegradability of LDPE/Starch Blown Film"

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- Allen, David J. "Stress-Strain Characteristics of Rubber-Like Materials: Experiment and Analysis"
- Chowdhury, Mostafiz R. "An Experiment on the Use of Disposable Plastics as a Reinforcement in Concrete Beams"
- Gorman, Thomas M. "Designing, Engineering, and Testing Wood Structures"
- Lloyd, Isabel K., Kolos, Kimberly R., Mengaux, Edmond C., Luo, Huy, McCuen, Richard H., and Regan, Thomas M. "Structure, Processing and Properties of Potatoes"
- McClelland, H. T. "Laboratory Experiments from the Toy Store"
- Sorensen, Carl D. "Measuring the Surface Tension of Soap Bubbles"
- Wickman, Jerry L. and Plocinski, David. "A Senior Manufacturing Laboratory for Determining Injection Molding Process Capability"

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- Kundu, Nikhil K. "Performance of Thermal Adhesives in Forced Convection"
- Liu, Ping. "Solving Product Safety Problem on Recycled High Density Polyethylene Container"
- Wickman, Jerry L. "Thermoforming From a Systems Viewpoint"

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- Csernica, Jeffrey "Mechanical Properties of Crosslinked Polymer Coatings"
- Edblom, Elizabeth "Testing Adhesive Strength" & "Adhesives The State of the Industry"
- Elban, Wayne L. "Three-Point Bend Testing of Poly (Methyl Methacrylate) and Balsa Wood"
- Labana, S. S. "Recycling of Automobiles an Overview"
- Liu, Ping and Tommy L. Waskom, "Application of Materials Database (MAT.DB) to Materials Education and Laminated Thermoplastic Composite Material"
- Marshall, John A. "Liquids That Take Only Milliseconds to Turn into Solids"
- Quaal, Karen S. "Incorporating Polymeric Materials Topics into the Undergraduate Chemistry Core Curriculum: NSF-Polyed Scholars Project: Microscale Synthesis and Characterization of Polystyrene"

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Callister, William, "Unknown Determination of a Steel Specimen"

Elban, Wayne L., "Metallographic Preparation and Examination of Polymer-Matrix Composites"

Shih, Hui-Ru, "Some Experimental Results in the Rolling of Ni<sub>3</sub>Al Alloy"

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Callister, Jr., William D., "Identification of an Unknown Steel Specimen"

Elban, Wayne L., "Metallurgical Evaluation of Historic Wrought Iron to Provide Insights into Metal-Forming Operations and Resultant Microstructure"

Griffin, R. B., Cornwell, L. R., Ridings, Holly E., "The Application of Computers to the Determination of Corrosion Rates for Metals in Aqueous Solutions"

Hilden, J., Lewis, K., Meamaripous, Selvaduray, Guna, "Measurement of Springback Angle in Sheet Bending"

Moss, T. S., Dye, R. C., "Experimental Investigation of Hydrogen Transport Through Metals"

Olesak, Patricia J., "2nd Steel Heat Treatment Lab: Austempering"

Spiegel, F. Xavier, "A Magnetic Dilemma: A Case Study"

Werstler, David E., "Lost Foam Casting"

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Dalton, William K., Olesak, Patricia J. "Making a Phase Diagram"

Kin, Yulian, Abramowitz, Harvey, Hentea, Toma, Xu, Ying. "Life Estimate Based on Fatigue Crack Propagation"

Werstler, David. "Case Studies in Metal Failure and Selection"

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Nagy, James P. "Sensitization of Stainless Steel"

Neville, J. P. "Crystal Growing"

Pond, Robert B. "A Demonstration of Chill Block Melt Spinning of Metal"

Shull, Robert D. "Low Carbon Steel: Metallurgical Structure vs Mechanical Properties"

### **NEW:Update 89**

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Balsamel, Richard. "The Magnetization Process - Hysteresis"

Beardmore, Peter. "Future Automotive Materials - Evolution or Revolution"

Bunnell, L. Roy. "Hands-On Thermal Conductivity and Work-Hardening and Annealing in Metals"

Kazem, Sayyed M. "Thermal Conductivity of Metals"

Nagy, James P. "Austempering"

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Bates, Seth P. "Charpy V-Notch Impact Testing of Hot Rolled 1020 Steel to Explore Temperature Impact Strength Relationships"

Chung, Wenchiang R. and Morse, Margery L. "Effect of Heat Treatment on a Metal Alloy"

Rastani, Mansur. "Post Heat Treatment in Liquid Phase Sintered Tungsten-Nickel-Iron Alloys"

Spiegel, F. Xavier. "Crystal Models for the Beginning Student"

Yang, Y. Y. and Stang, R. G. "Measurement of Strain Rate Sensitivity in Metals"

### **NEW:Update 91**

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Cowan, Richard L. "Be-Cu Precipitation Hardening Experiment"

Kazem, Sayyed M. "Elementary Metallography"

Krepski, Richard P. "Experiments with the Low Melting Indium-Bismuth Alloy System"

Lundeen, Calvin D. "Impact Testing of Welded Samples"

McCoy, Robert A. "Cu-Zn Binary Phase Diagram and Diffusion Couples"

Patterson, John W. "Demonstration of Magnetic Domain Boundary Movement Using an Easily Assembled Videocam-Microscope System"

Widener, Edward L. "Heat-Treating of Materials"

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Dahiya, Jai N. "Phase Transition Studies in Barium and Strontium Titanates at Microwave Frequencies"

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Walsh, Daniel W. "Visualizing Weld Metal Solidification Using Organic Analogs"

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Guichelaar, Philip J. "The Anisotropy of Toughness in Hot-Rolled Mild Steel"

Martin, Donald H. "From Sand Casting TO Finished Product (A Basic University-Industry Partnership)"

Petit, Jocelyn I. "New Developments in Aluminum for Aircraft and Automobiles"

Smith, R. Carlisle "Crater Cracking in Aluminum Welds"

### **NEW:Update 94**

**NASA Conference Publication 3304**

Gabrykewicz, Ted, "Water Drop Test for Silver Migration"

Kavikondala, Kishen and Gambrell, Jr., S. C., "Studying Macroscopic Yielding in Welded Aluminum Joints Using Photostress"

Krepski, Richard P., "Exploring the Crystal Structure of Metals"

McClelland, H. Thomas, "Effect of Risers on Cast Aluminum Plates"

Weigman, Bernard J. and Courpas, Stamos, "Measuring Energy Loss Between Colliding Metal Objects"

McCoy, Robert A. "How a Heat Pack Works"  
Nydam, Andrew. "Low Dollar Tensile (Torsion) Tester"  
Song, Kyo D. "Design of Hypervelocity Flow Generator and Its Flow Visualizations"  
Spiegel, F. Xavier. "Medicine, Magic, Materials, and Mankind"  
Whang, Kyumin and Hsu, Matthew. "Evaluating the Strength and Biodegradation of a Gelatine-Based Material"  
Williams, John R. "Corrosion Demonstration Utilizing Low Cost Materials"

Werstler, David E., "Introduction to Nondestructive Testing"  
White, Charles V., "Glass Fracture Experiment for Failure Analysis"  
Wickman, Jerry L. and Kundu, Nikhil K., "Failure Analysis of Injection Molded Plastic Engineered Parts"  
Widener, Edward L., "Dimensionless Fun With Foam"

**NEW:Update 95**

**NASA Conference Publication 3330**

Brown, Scott, "Crystalline Hors d'oeuvres"  
Karplus, Alan K., "Craft Stick Beams"  
Kern, Kristen, "ION Beam Analysis of Materials"  
Kozma, Michael, "A Revisit to the Helicopter Factorial Design Experiment"  
Pond, Robert B., Sr., "Recrystallization Art Sketching"  
Roy, Rustum, "CVD Diamond Synthesis and Characterization: A Video Walk-Through"  
Saha, Hrishikesh, "Virtual Reality Lab Assistant"  
Spiegel, F. Xavier, "A Novel Approach to Hardness Testing"  
Spiegel, F. Xavier, "There are Good Vibrations and Not So Good Vibrations"  
Tognarelli, David, "Computerized Materials Testing"  
Wickman, Jerry L., "Cost Effective Prototyping"

**NEW:Update 96**

**NASA Conference Publication 3354**

Chao, Julie, Currotto, Selene, Anderson, Cameron, Selvaduray, Guna, "The Effect of Surface Finish on Tensile Strength"  
Fabris, Neda S., "From Rugs to Demonstrations in Engineering Materials Class"  
Ferguson, Luke, Stoebe, Thomas, "Hysteresis Loops and Barkhausen Effects in Magnetic Materials"  
Karplus, Alan K., "Holy Holes or Holes Can Make Tensile Struts Stronger"  
Koon, Daniel W., "Relaxation and Resistance Measurements"  
Liu, Ping, Waskom, Tommy L., "Composite of Glass Fiber with Epoxy Matrix"  
Song, Kyo D., Ries, Heidi R., Scotti, Stephen J., Choi, Sang H., "Transpiration Cooling Experiment"  
South, Joe, Keilson, Suzanne, Keefer, Don, "In-Vivo Testing of Biomaterials"  
Thorogood, Michael G., "Tensile Test Experiments With Plastics"  
Widener, Edward L., "Brinelling the Malay Snail"

**NEW:Update 97**

**NASA Conference Publication**

Banerjee, Gautam, Miller, Albert E. "Understanding Galvanic Corrosion Tricks to Prevent Some Expensive Failures"  
Cadwell, John and Eric, Piippo, Steven. "Strength Testing of Composite Materials"  
Diez, C. Ray. "Case Hardening: An Activity to Demonstrate Brinnell Hardness"  
Erickson, Glen C., Chung, W. Richard. "Effectiveness of Ultrasonic Testing Method in Detecting Delamination Effects in Thick Composites"  
Fabris, Neda S. "Learning More From Tensile Test Experiments"  
Fine, Leonard W. "Demonstrating the Critical Properties of Carbon Dioxide"  
Goranson, Ulf. "Jet Transport Structures Performance Monitoring"  
Griffin, R. B., Cornwell, L. R. "Measurement of the Modulus of Elasticity Using a Three-Point Bend Test"  
Homidany, Mtrook Al, Weick, Brian L. "A Device for Measuring the Elastic Modules of Spherical Materials"  
Hudson, John B., Svanes, Torkel, Bryson, Daniel, Sawyer, W. Gregory, "An Interactive Molecular Dynamics Simulation of Atomic Behavior"  
Liu, Paul Cheng-Hsin, Moore, Kenneth, Ogu, Chris. "Rapid Prototyping Processes and Procedures"  
Loutts, George B. "Crystal Growth of Mixed Optical Materials With the Automatic Czochralski Puller"  
Masi, James V. "Experiments in Diffusion: Gases, Liquids, and Solids For Under Five Dollars"

**NEW:Update 92****NASA Conference Publication 3201**

- Bunnell, L. Roy. "Temperature-Dependent Electrical Conductivity of Soda-Lime Glass and Construction and Testing of Simple Airfoils to Demonstrate Structural Design, Materials Choice, and Composite Concepts"
- Marpert, Mark I. "Walkway Friction: Experiment and Analysis"
- Martin, Donald H. "Application of Hardness Testing in Foundry Processing Operations: A University and Industry Partnership"
- Masi, James V. "Experiments in Corrosion for Younger Students By and For Older Students"
- Needham, David. "Micropipet Manipulation of Lipid Membranes: Direct Measurement of the Material Properties of a Cohesive Structure That is Only Two Molecules Thick"
- Perkins, Steven W. "Direct Tension Experiments on Compacted Granular Materials"
- Shih, Hui-Ru. "Development of an Experimental Method to Determine the Axial Rigidity of a Strut-Node Joint"
- Spiegel, F. Xavier. "An Automated Data Collection System For a Charpy Impact Tester"
- Tipton, Steven M. "A Miniature Fatigue Test Machine"
- Widener, Edward L. "Tool Grinding and Spark Testing"

**NEW:Update 93****NASA Conference Publication 3259**

- Borst, Mark A. "Design and Construction of a Tensile Tester for the Testing of Simple Composites"
- Clum, James A. "Developing Modules on Experimental Design and Process Characterization for Manufacturing/Materials Processes Laboratories"
- Diller, T. E. and A. L. Wicks, "Measurement of Surface Heat Flux and Temperature"
- Denton, Nancy and Vernon S. Hillsman, "An Introduction to Strength of Materials for Middle School and Beyond"
- Fisher, Jonathan H. "Bridgman Solidification and Experiment to Assess Boundaries and Interface Shape"
- Gray, Jennifer "Symmetry and Structure Through Optical Diffraction"
- Karplus, Alan K. "Knotty Knots"
- Kohne, Glenn S. "An Automated Digital Data Collection and Analysis System for the Charpy Impact Tester"
- Olesak, Patricia J. "Scleroscope Hardness Testing"
- Speigel, F. Xavier, "Inexpensive Materials Science Demonstrations"
- Wickman, J. L. "Plastic Part Design Analysis Using Polarized Filters and Birefringence"
- Widener, Edward L. "Testing Rigidity by Torque Wrench"

**NEW:Update 94****NASA Conference Publication 3304**

- Bruzan, Raymond and Baker, Douglas, "Density by Titration"
- Dahiya, Jai N., "Precision Measurements of the Microwave Dielectric Constants of Polyvinyl Stearate and Polyvinylidene Fluoride as a Function of Frequency and Temperature"
- Daufenbach, JoDee and Griffin, Alair, "Impact of Flaws"
- Fine, Leonard W., "Concrete Repair Applications and Polymerization of Butadiene by an "Alfin" Catalyst"
- Hillsman, Vernon S., "Stress Concentration: Computer Finite Element Analysis vs. Photoelasticity"
- Hutchinson, Ben, Giglio, Kim, Bowling, John, and Green, David, "Photocatalytic Destruction of an Organic Dye Using  $TiO_2$ "
- Jenkins, Thomas J., Comtois, John H., and Bright, Victor M., "Micromachining of Suspended Structures in Silicon and Bulk Etching of Silicon for Micromachining"
- Jacobs, James A. and Jenkins, Thomas J., "Mathematics for Engineering Materials Technology Experiments and Problem Solving"
- Karplus, Alan K., "Paper Clip Fatigue Bend Test"
- Kohne, Glenn S., "Fluids With Magnetic Personalities"
- Liu, Ping and Waskom, Tommy L., "Ultrasonic Welding of Recycled High Density Polyethylene (HDPE)"
- Martin, Donald H., Schwan, Hermann, Diehm, Michael, "Testing Sand Quality in the Foundry (A Basic University-Industry Partnership)"
- Shull, Robert D., "Nanostructured Materials"

## LISTING OF EXPERIMENTS FROM NEW:UPDATES

### EXPERIMENTS & DEMONSTRATIONS IN STRUCTURES, TESTING, AND EVALUATION

#### NEW:Update 88

NASA Conference Publication 3060

Sastri, Sankar. "Fluorescent Penetrant Inspection"

Sastri, Sankar. "Magnetic Particle Inspection"

Sastri, Sankar. "Radiographic Inspection"

#### NEW:Update 89

NASA Conference Publication 3074

Chowdhury, Mostafiz R. and Chowdhury, Farida. "Experimental Determination of Material Damping Using Vibration Analyzer"

Chung, Wenchiang R. "The Assessment of Metal Fiber Reinforced Polymeric Composites"

Stibolt, Kenneth A. "Tensile and Shear Strength of Adhesives"

#### NEW:Update 90

NIST Special Publication 822

Azzara, Drew C. "ASTM: The Development and Application of Standards"

Bates, Seth P. "Charpy V-Notch Impact Testing of Hot Rolled 1020 Steel to Explore Temperature Impact Strength Relationships"

Chowdhury, Mostafiz R. "A Nondestructive Testing Method to Detect Defects in Structural Members"

Cornwell, L. R., Griffin, R. B., and Massarweh, W. A. "Effect of Strain Rate on Tensile Properties of Plastics"

Gray, Stephanie L., Kern, Kristen T., Harries, Wynford L., and Long, Sheila Ann T.

"Improved Technique for Measuring Coefficients of Thermal Extension for Polymer Films"

Halperin, Kopl. "Design Project for the Materials Course: To Pick the Best Material for a Cooking Pot"

Kundu, Nikhil. "Environmental Stress Cracking of Recycled Thermoplastics"

Panchula, Larry and Patterson, John W. "Demonstration of a Simple Screening Strategy for Multifactor Experiments in Engineering"

Taylor, Jenifer A. T. "How Does Change in Temperature Affect Resistance?"

Wickman, Jerry L. and Corbin, Scott M. "Determining the Impact of Adjusting Temperature Profiles on Photodegradability of LDPE/Starch Blown Film"

Widener, Edward L. "It's Hard to Test Hardness"

Widener, Edward L. "Unconventional Impact-Toughness Experiments"

#### NEW:Update 91

NASA Conference Publication 3151

Bunnell, L. Roy. "Tempered Glass and Thermal Shock of Ceramic Materials"

Lundeen, Calvin D. "Impact Testing of Welded Samples"

Gorman, Thomas M. "Designing, Engineering, and Testing Wood Structures"

Strehlow, Richard R. "ASTM - Terminology for Experiments and Testing"

Karplus, Alan K. "Determining Significant Material Properties A Discovery Approach"

Spiegel, F. Xavier and Weigman, Bernard J. "An Automated System for Creep Testing"

Denton, Nancy L. and Hillsman, Vernon S. "Isotropic Thin-Walled Pressure Vessel Experiment"

Allen, David J. "Stress-Strain Characteristics of Rubber-Like Materials: Experiment and Analysis"

Dahl, Charles C. "Computer Integrated Lab Testing"

Cornwell, L. R. "Mechanical Properties of Brittle Material"



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Technical notebooks and announcements of the workshop were provided by  
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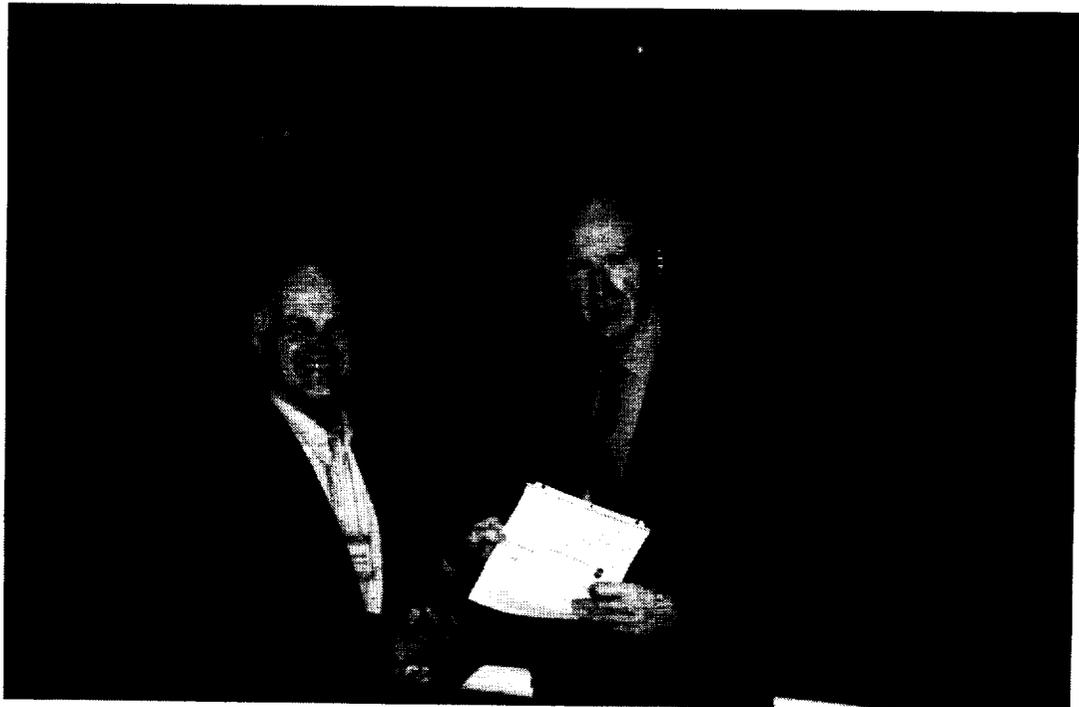
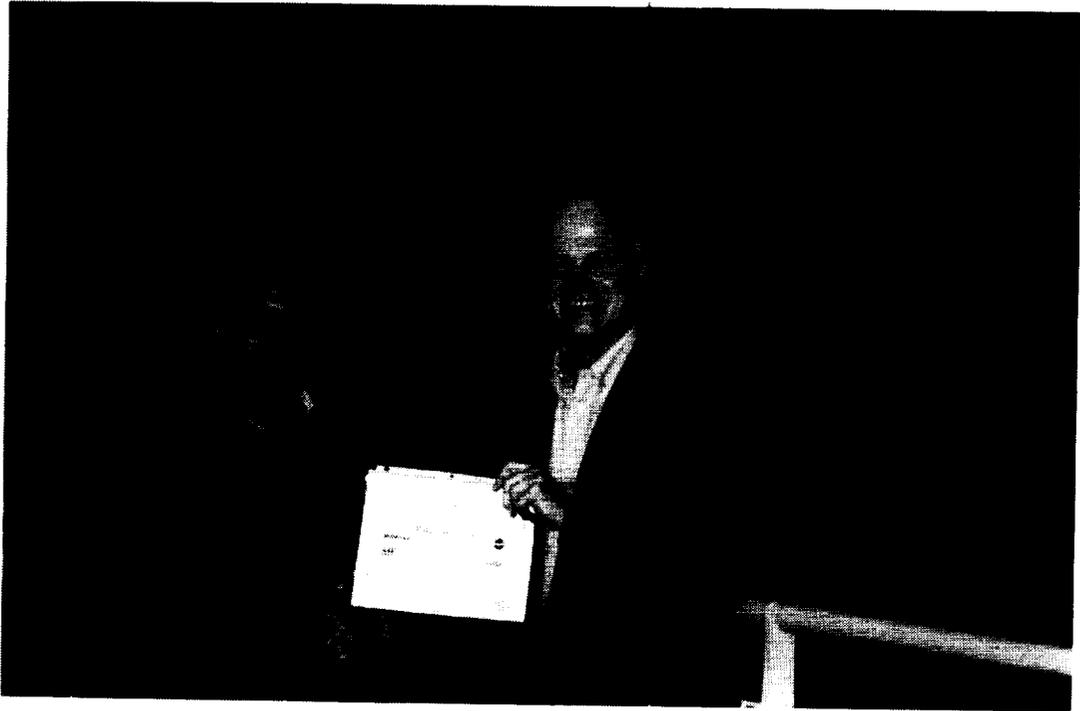
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## RECOGNIZING CONTRIBUTIONS



**RECOGNIZING CONTRIBUTIONS (CONCLUDED)**



## REGISTRATION



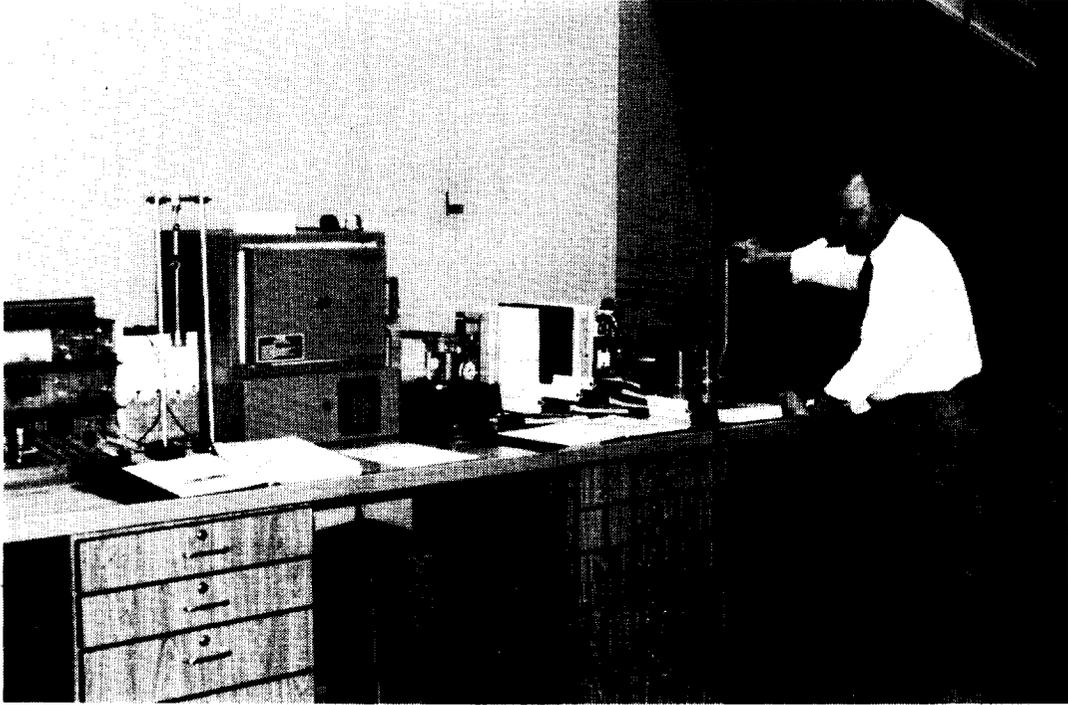
**Diana LaClaire, Ginger Freeman, and Brian Smith**



## DISPLAYS



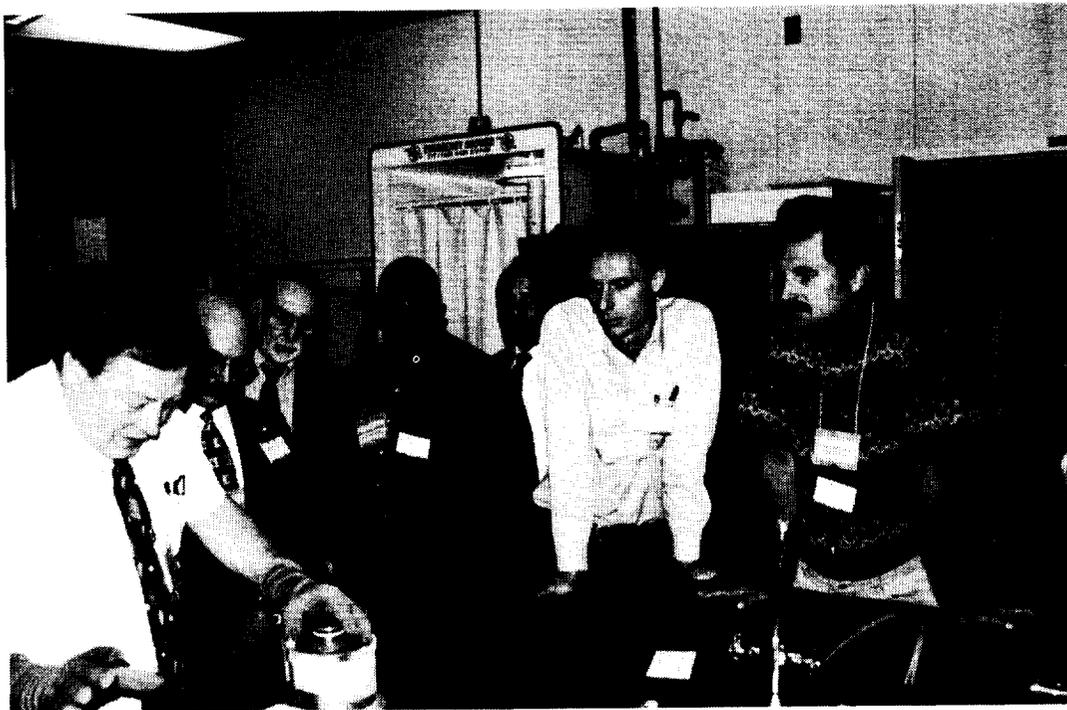
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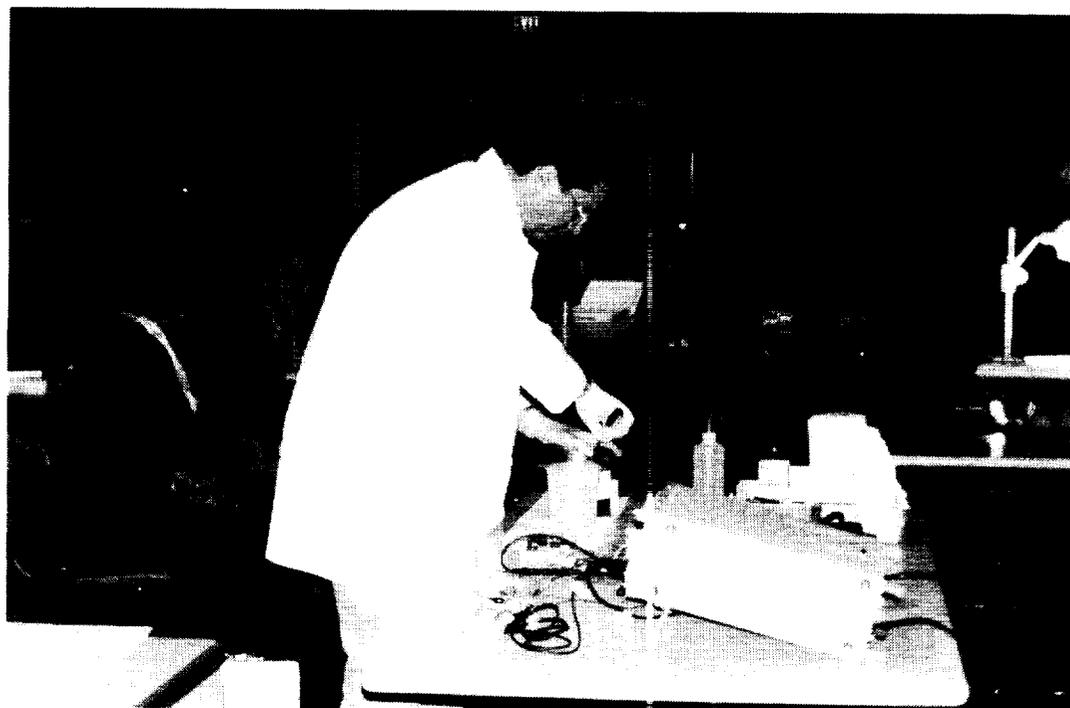
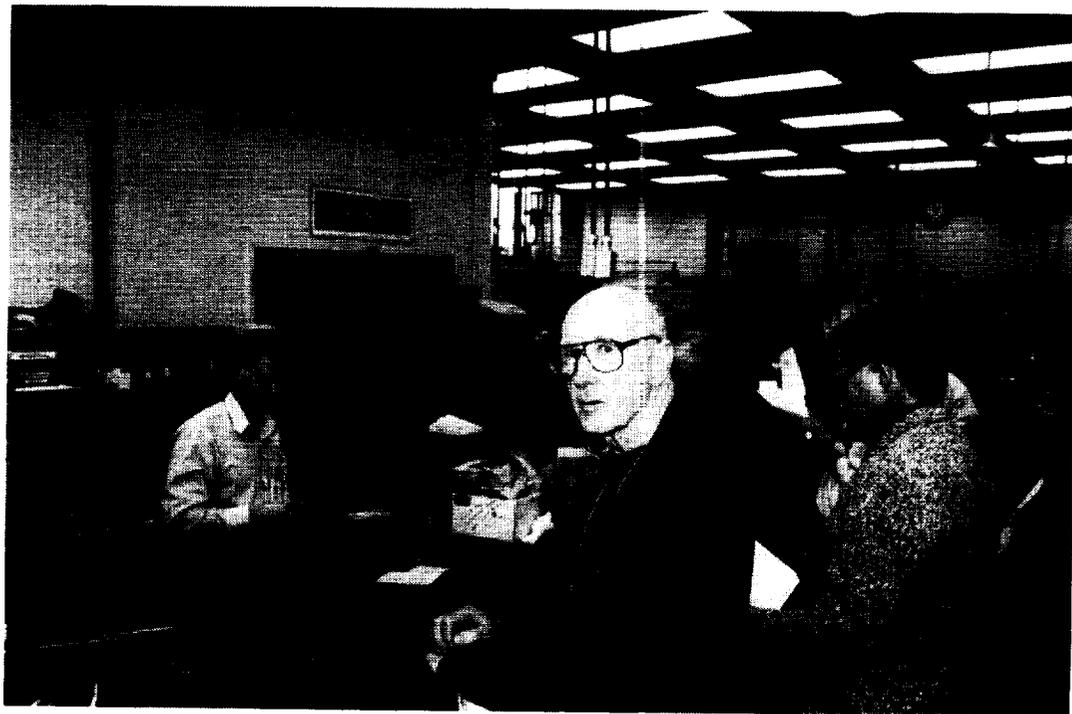
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MINI WORKSHOPS (CONTINUED)



MINI WORKSHOPS (CONCLUDED)



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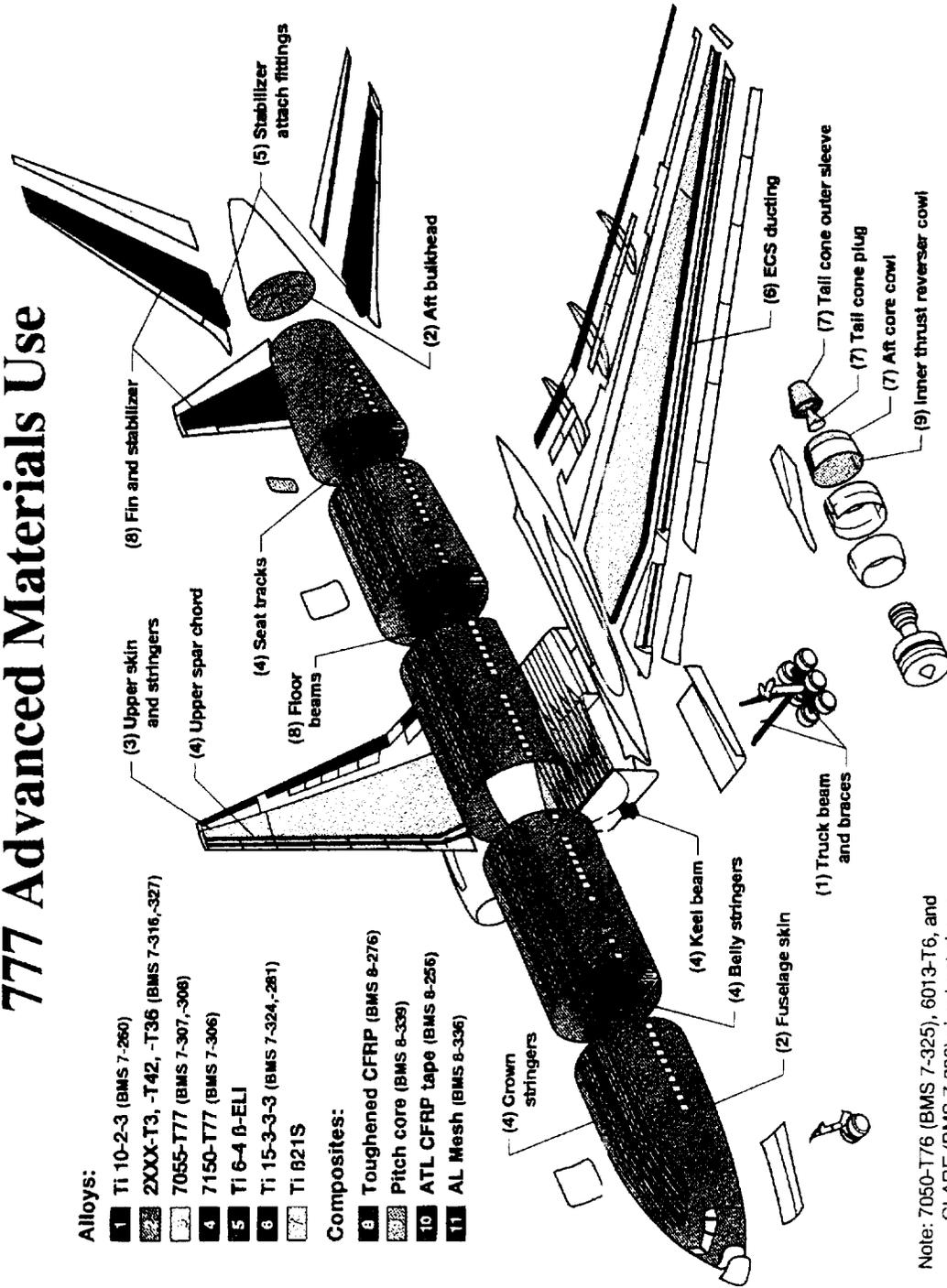
# 777 Advanced Materials Use

## Alloys:

- 1 Ti 10-2-3 (BMS 7-260)
- 2 2XXX-T3, -T42, -T36 (BMS 7-316,-327)
- 3 7055-T77 (BMS 7-307,-308)
- 4 7150-T77 (BMS 7-306)
- 5 Ti 6-4 0-ELI
- 6 Ti 15-3-3-3 (BMS 7-324,-281)
- 7 Ti 021S

## Composites:

- 8 Toughened CFRP (BMS 8-276)
- 9 Pitch core (BMS 8-339)
- 10 ATL CFRP tape (BMS 8-256)
- 11 AL Mesh (BMS 8-336)



Note: 7050-T76 (BMS 7-325), 6013-T6, and GLARE (BMS 7-326) sheet not shown